15. (NOT CHANGED) The casting die as recited in claim 12, wherein between the coolant channels, additional cooling bore holes are arranged.

REMARKS

Claims 1-15 are pending in the application and stand rejected for various formal and substantive reasons. In view of the foregoing amendments and the discussion that follows, Applicants respectfully request reconsideration and withdrawal of the rejections.

1. **Formal Objections**

The specification has been amended to correct various typographical and grammatical errors. No new matter has been added. Entry of amendment and withdrawal of the formal objections are requested.

2. **Objection to Drawing**

Responsive to the Examiner's objections to FIGS. 1 and 2, Applicants submit herewith a Proposed Drawing Corrections, identifying the proposed changes in red ink. Applicants submit that the proposed correction obviate the Examiner's objections. A notice to this effect is hereby solicited.

3. Claims 1-5 are not Anticipated

Claims 1-5 stand rejected as allegedly anticipated by the English Language Translation of WO 97/43063 to Stagge et al. For at least the reasons that follow, Applicants respectfully request reconsideration and withdrawal of this rejection.

The claimed invention is directed to a method and apparatus for continuous casting wherein the die's geometry compounds the thermal and mechanical stress in certain areas of the die. Applicants disclose that, for example, the corner areas of a funnel in a plate-type casting present a special problem as abutting edges may have non-uniform heat transfer rates, which would lead to structural defect (*e.g.*, the softening of the casting die in these areas). Accordingly, Applicants contemplate a continuous casting device wherein the heat transfer rate is increased in the thermally and mechanically stresses areas as compared with the balance of the die. Claim 1, as amended herein, recites a liquid-cooled casting die wherein the cooling rate in *mechanically and thermally stressed* area is increased as compared with the rest of the die.

Stagge is directed to a liquid-cooled mold for strand casting thin iron slabs wherein the copper plates are fastened to the supporting plate via metal bolts. Stagge explains that the stainless steel bolts connecting the copper plate to the supporting plate are disadvantageous as they weld poorly to the copper plate. The reference explains that the problems is caused by the different grain type/size in the bolt material and the plate material. To overcome this problem, Stagge discloses selectively molding metal bolts of a mold body from a CuNiFe alloy to increase stability of the welded joints with

the copper plate. See, for example, page 3, lines 3-6. In addition, Stagge discloses placing slot-like coolant channels in the broadside walls in order to implement cooling of the die broadside wall.

Applicants respectfully submit that Stagge does not disclose or suggest the invention of claim 1. Specifically, Stagge does not disclose or suggest raising the heat flow in the mechanically and thermally stressed areas as compared to the rest of the die surface. While Stagge allegedly teaches providing coolant channels along the broadside walls, this reference does not disclose the feature of *increasing* heat transfer in the mechanically and thermally stressed parts of the die as compared to the other areas of the die. Indeed, Stagge does not even recognize the problem contemplated by Applicants.

For at least this reason, it is respectfully submitted that Stagge does not anticipate or render obvious the invention of claim 1. Claims 2-5 are deemed patentable at least by the virtue of their dependence on claim 1. Reconsideration and withdrawal of the anticipation rejection over Stagge is respectfully requested.

4. Claims 6-7 are patentable

Claims 6 and 7 stand rejected as allegedly obvious over Stagge in view of U.S. Patent No. 5,095,970 to Klein et al. ("Klein"). Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claims 6 and 7 for at least the following reasons.

First, claims 6 and 7 depend from claim 1, which as amended, is neither anticipated nor rendered obvious by Stagge. Accordingly, claims 6 and 7 are patentable at least by the virtue of their dependence on claim 1, which as explained is deemed allowable.

Second, Klein is predominantly concerned with the problem of over cooling of the corner areas in casting strips of limited thickness (6-30 mm). In this regard, the reference discloses that extended solidification of the mold in corner areas, as compared to the more central areas, can cause breakout of the strands during the starting operation. See col. 1, lines 15-23. To overcome this problem, the reference discloses:

> The object is achieved according to the invention in that the cooling device is arranged solely on the wide sides of the mold cavity defining body and, starting from the bottom edge of the mold, extends approximately up to 55-75% of the height of the wide side, and that the narrow sides are uncooled.
>
> Col. 1, lines 29-34.

Thus, while Stagge stresses cooling the broadside walls, the secondary reference, Klein, teaches that the side walls should not be cooled. Since the teachings of the references contradict each other, Applicants respectfully submit that a *prima facie* case of obviousness is not established. See MPEP § 2143 ("If the proposed modification or combination of the prior art would change the principle of the operation of the prior art invention being modified, then the teachings of the

references are not sufficient to render the claims *prima facie* obvious." citing *In re Ratti,* 270 F.2d 810, 123 USPQ 349.)

5. Claims 8-9 are patentable

Claims 8 and 9 stand rejected as allegedly obvious over Stagge in view of U.S. Patent No. 5,117,895 to Hargassner et al. ("Hargassner"). Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claims 8 and 9 for at least the following reasons.

Claims 8 and 9 depend from claim 1, which as amended, is neither anticipated nor rendered obvious by Stagge. Accordingly, claims 8 and 9 are patentable at least by the virtue of their dependence on claim 1, which as explained is deemed allowable.

Moreover, Hargassner discloses providing effective cooling by making the width of the cooling ribs smaller then, or equal to 13 mm while adjusting the coolant speed to maintain the heat transmission coefficient between 20 and 70 kW/m^2K. Thus, Hargassner fails to cure deficiencies of Stagge.

Accordingly, Applicants respectfully submitted that claims 8 and 9 are patentable over the references. Reconsideration and withdrawal of this rejection is respectfully requested.

6. Claims 10-11 are patentable

Claims 10 and 11 stand rejected as allegedly obvious over Stagge in view of U.S. Patent No. 5,899,259 to Rode et al. ("Rode"). Applicants respectfully request reconsideration and

withdrawal of the obviousness rejection of claims 10 and 11 for at least the following reasons.

Claims 10 and 11 depend from claim 1, which as amended, is neither anticipated nor rendered obvious by Stagge. Accordingly, claims 10 and 11 are patentable at least by the virtue of their dependence on claim 1, which as explained is deemed allowable.

Moreover, since the U.S. filing date of Rode, October 21, 1998, doe not predate the priority date of Applicants' invention, January 27, 1998, it is not considered prior art.

Reconsideration and withdrawal of this rejection is respectfully requested.

7. **<u>Claims 12-15 are patentable</u>**

Claims 12-15 stand rejected as allegedly obvious over Stagge in view of U.S. Patent No. 5,207,266 to Nakashima et al. ("Nakashima"). Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claims 12-15 for at least the following reasons.

Claims 12-15 depend from claim 1, which as amended, is neither anticipated nor rendered obvious by Stagge. Accordingly, claims 12-15 are patentable at least by the virtue of their dependence on claim 1, which as explained is deemed allowable.

Reconsideration and withdrawal of this rejection are respectfully requested.

In view of the foregoing, reconsideration and allowance of this application are now believed to be in order, and such action is hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

Applicants hereby request that the Office charge any appropriate extension of time fee which may be required to maintain the pendency of this case, and any other required fee, except for the Issue Fee, to Deposit Account No. 11-0600.

Respectfully submitted,

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Date MAR 21, 2001

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MARKED UP VERSION OF SPECIFICATION SHOWING CHANGES MADE

A marked-up version of the first paragraph on page 2, line 1, follows:

R1

B

It is also known to provide improved cooling to casting dies subject to particularly high thermal stresses, in order to avoid premature damage to the casting die. This means in the case of thin-slab casting dies, that the thermal resistance of the casting die wall should not be too great, for which reason thinner walls are chosen. Moreover, given the higher pouring rates that are targeted ~~thattargeted~~, particular demands are placed on cooling-water quality and flow rate.

A marked-up version of third paragraph on page 2 beginning at line 18, follows:

R2

The local conditions of stress in the use of funnel casting die plates are dependent on the operating conditions. On the pouring side, they are basically determined by the kind of steel pouring temperature, the speed, the lubrication/cooling conditions of the pouring powder, the geometry of the pouring nozzle, and the corresponding flow of the molten mass. On the other side, the water side, the casting die temperatures are determined by the quality, quantity, and flow rate of the cooling water. These variables are partly determined already by the casting die design, such as in the geometry of the coolant channels.

A marked-up version of the last paragraph on page 3 beginning at line 28, follows:

R3

This leads to a particularly pronounced softening of the casting die material in this transitional area of the funnel. As a result of the locally relatively higher temperatures and the higher material loads related to the respective resistance to heat of a material-volume element, cracks can appear prematurely in this surface area. These cracks are more likely to occur due to a diffusion process, marked here as temperature dependent, of Zn-atoms from the steel into the Cu-matrix, because the Cu-Zn phases which arise form a hard and brittle surface layer which makes possible higher rate of crack formation.

N.E. wrong?

A marked-up version of the paragraph on page 5 beginning at line 3, follows:

Alternatively, the coolant channels can be brought closer to the surface locally; in this case, the system operates, in an unusual fashion, with varying -- effectively active -- cooling wall thicknesses above the cooling water. The same applies to the cooling bore holes. In addition, broad-side plates, configured having groove-shaped coolant channels, in the critical areas of the funnel transition can be provided with additional cooling bore holes; in a surprising manner, in spite of the small wall thickness, the resistance to cracks of the casting die material is also increased here and with it the overall durability of the casting die plate.

A marked-up version of the paragraph on page 6 beginning at line 4, follows:

B

Thus a maximum surface temperature is reduced by 28°C; this preferred cooling is maintained given appropriate reworking of casting die plate 1. although the wall thickness d2 in critically stressed area 5 is 2 mm smaller, the result, surprisingly, is still a generally greater service lifetime of casting die plate 1, including reworking. Area 5, which is more intensively cooled due to cooling grooves 6 that are placed deeper (wall thickness between pouring and cooling surface 18 mm instead of 20 mm), extends, in the present case, over the following surfaces (see Figure 1): the horizontal length from turning point B of funnel 2 more than 370 mm to end point D. The more intensive cooling surface extends from plate upper edge 7 up to 200 mm in the pouring direction GR; adjoining is a transitional zone 8 of 50 mm, in which the depth d of cooling grooves 6 is adjusted.

A MARKED-UP VERSION OF THE CLAIMS SHOWING CHANGES MADE

1. (AMENDED) A liquid-cooled casting die for a continuous billet casting comprising:

a form-giving casting die body made of a material of high heat conductivity, the casting die body having a cooling-surface side in thermally and mechanically stressed areas thereof,

Sub B1

wherein the casting die body has a cooling zone on said cooling-surface side, said cooling zone having a greater rate of heat flow relative to the remainder of the surface of the casting die providing increased cooling rate in the critically stresses areas the casting die.

Sub D1

2. (NOT CHANGED) The casting die body as recited in claim 1, wherein the form-giving casting die body is made of copper or a copper alloy.

3. (AMENDED) The casting die as recited in claim 1, further comprising a die cavity having of two broad-side walls situated opposite each other and two narrow-side walls limiting the width of the billet forming a cross-section of the die cavity; said broad-side walls connected to a base and forming meniscus thereon.

Sub B2

4. (AMENDED) The casting die as recited in claim 3, wherein the cross-section of the die cavity at a first end is greater than at a second end.

Sub D1

Sub B3

5. (AMENDED) The casting die as recited in claim 3, wherein the die cavity at the first end has at least one hollow space which can becomes smaller in the toward the second end.

SUB B1

6. (AMENDED) The casting die as recited in claim 1, wherein the cooling zone having a greater surface-related heat flow is arranged in a bath surface area, the cooling zone extending to at least 20% of the length of the meniscus of the broad-side wall.

7. (AMENDED) The casting die as recited in claim 6, wherein the cooling zone having a greater surface-related heat flow is arranged in a bath surface area, the cooling zone extending to 30-60% of the length of the meniscus of the broad-side wall.

8. (NOT CHANGED) The casting die as recited in claim 1, wherein the surface-related heat flow in the more stressed area of the bath surface is 5-40% greater than in the other areas of the bath surface.

Sub B4

9. (NOT CHANGED) The casting die as recited in claim 8, wherein the surface-related heat flow in the more stressed area of the bath surface is 10-20% greater than in the other areas of the bath surface.

10. (AMENDED) The casting die as recited in claim 1, wherein the wall thickness separating the die from the bath is reduced in thermally and mechanically stressed areas of the broad-side walls.

B1 Cont'd

11. (AMENDED) The casting die as recited in claim 10, wherein the wall between the pouring and the cooling surface of the bath surface area has a thickness that is reduced by 1 to 6 mm.

12. (AMENDED) The casting die as recited in claim 1, wherein the casting die body, in a direction running parallel to the direction form the first end to the second end further comprises at least one groove-shaped coolant channel or cooling bore holes, which in the thermally and mechanically stressed areas are configured narrower than in other areas.

13. (AMENDED) The casting die as recited in claim 12, wherein the spacing of the coolant channels or cooling bore holes in the thermally and mechanically stressed areas is at least 20% less than in the horizontal adjacent areas of the bath surface.

SUB D3

14. (NOT CHANGED) The casting die as recited in claim 12, wherein the coolant channels or the cooling bore holes are arranged in a transitional area so as to become gradually narrower.

15. (NOT CHANGED) The casting die as recited in claim 12, wherein between the coolant channels, additional cooling bore holes are arranged.